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From: Edward M. Weisz, Esq.
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Our File: 33900-73PUS
Serial No. 09/623,208

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Attorney Docket # 33900-73PUS

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Michel BAYLOT et al.

Serial No.: 09/623,208

Filed: August 29, 2000

For: Device and Process for the Heat Insulation of at
Least One Underwater Pipe at Great DepthExaminer: McKinnon, T.
Group Art: 3743I hereby certify that this correspondence is being
deposited with the United States Postal Service with
sufficient postage as first class mail in an envelope
addressed to: Assistant Commissioner for Patents,
Washington, D.C. 20231, on

February 11, 2002

(Date of Deposit)

Bryan B. Pavan

Name of applicant, licensee or Registered Representative

Signature

February 11, 2002

Date of Signature

Assistant Commissioner for Patents
Washington, DC 20231RESPONSE TO OFFICE ACTION DATED OCTOBER 9, 2001

SIR:

Applicant hereby responds to the Office Action dated October 9, 2001 as
follows:

In the Specification

On page 1, After the Title, insert:

"BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION".

On page 1, after line 11, insert:

"DESCRIPTION OF THE RELATED ART".

On page 5, after line 12, insert:

"BRIEF DESCRIPTION OF THE INVENTION".

On page 10, after line 8, insert:

"BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS".

On page 11, after line 10, insert:

"DETAILED DESCRIPTION OF THE INVENTION".

In the Claims

Please add new claims 29 and 30, and amend claim 11 to read as follows:

11. (Twice Amended) Device according to claim 1, characterized in that said virtually incompressible material (4) is constituted, to at least 90%, of chemical compounds of the family of alkanes.

29. (New) Device according to claim 11, wherein said incompressible material (4) is a paraffin comprising a hydrocarbon chain with at least 10 carbon atoms.

30. (New) Device according to claim 1, wherein said at least one underwater pipe is disposed on said sea bed.

REMARKS

In the outstanding Action, the Examiner rejected claims 1-6, 8 and 10 under 35 U.S.C. § 103(a) as obvious over Best (United States Patent No. 3,948,313) in view of Watkins (United States Patent No. 6,058,979), and rejected claim 11 under 35 U.S.C. § 112 (2nd ¶) as indefinite. The Examiner also objected to claims 7, 9 and 12-25 as depending from a rejected independent claim (claim 1), and allowed claims 26-28.

The Examiner also requested the addition of section headings to the specification. All pertinent headings have been added by the amendment above.

As to the rejections, the applicant respectfully submits that the claims present allowable subject matter and, after the above amendment to claim 11, are all in allowable form.

The instant invention is directed to a device for heat insulation of an underwater pipe, of the type used in an oil pipeline, and which is specifically intended to be laid on the sea bed at a great depth (claim 1, lines 1-2; claim 30). The design concerns for an underwater oil pipe are different from those for oil pipes located on or near the surface, especially where the surface is permafrost, the intended environment for the pipes disclosed in Best (see Best, *e.g.* col. 1, lines 11-17). A schematic drawing prepared by the applicant, and showing the structure of Best, is enclosed.

The vastly different operating environments of these two types of pipelines lead to a distinction between the claimed invention and the pipeline disclosed in Best. Specifically, claim 1 (lines 3-6) explicitly requires that the insulating coating comprises a material having a melting temperature T_0 *higher than* the temperature T_2 of the medium surrounding the pipe, i.e. the freezing temperature of sea water, and less than the temperature T_1 of the effluents

circulating in the pipe. Best, however, describes an insulating liquid 24 having a freezing point of 30°F, which is *less than* the freezing point (32°F) of the medium (permafrost) surrounding the pipe (col. 4, lines 46-64)¹.

This is an important difference. The main object of Best is to maintain the exterior temperature of the insulated pipeline *below* the freezing point of the surrounding permafrost, so that the permafrost does not melt. Best expressly states that having the melting point of the insulating material lower than the melting point of the surrounding medium is beneficial, as it allows the insulating material to serve more effectively as a heat sink than if the melting point was higher than that of the surrounding medium (see col. 4, lines 59-65). This protects the surrounding medium (permafrost) against melting, which is Best's desired object. Accordingly, despite the Examiner's characterization of Best, the actual teachings thereof do not meet this specific claim limitation.

Thus, Best alone fails to teach or suggest the claimed invention. The addition of Watkins does not overcome these deficiencies. In the first instance, it would not be obvious to one of ordinary skill in the art to combine the teachings of a reference relating to permafrost pipeline structures (Best) with undersea pipeline structures (Watkins) because the considerations of each environment are nearly completely opposite, as described above. The

¹ The actual quote from the Best specification on this point is:

"A liquid 24 enclosed within the thermocell 18 can be a saline, glycol or other solution sufficient to give the thermocell heat sink a freezing point slightly less than the transition temperature of the surrounding permafrost (usually about 32°C) as, for example, 30°F." col. 4, lines 46-50.

It is evident that the reference to 32°C is a typographical error, and should read "32°F, since a temperature of 32°C would equal 87.6°F, which would be *significantly* higher than the freezing point of liquid 24, and would also lead to the melting of the permafrost, which would defeat the entire purpose of the Best device: to keep the temperature of the pipeline *lower* than ambient temperature, to avoid melting the permafrost. Additionally, Best consistently refers to °F in

Examiner cites Watkins, in fact, solely for the use of thermoplastic materials in pipelines, but does not suggest that Watkins contains any teachings that would enable one of ordinary skill in the art to deviate from Best's express teachings regarding the use of insulating materials having temperatures *lower than* the ambient material's melting point.

Thus the references, either alone or in combination, fail to teach or suggest the invention as claimed. Withdrawal of this rejection is therefore respectfully solicited.

In addition, the limitations of claim 2 are not fairly met by Best and Watkins, either alone or in combination. Claim 2 requires that the insulating coating comprises an absorbent matrix which is impregnated with the incompressible liquid/solid phase changing material. The Examiner has cited "matrix 22" of Best as meeting this limitation (Office Action, pages 4-5), but it is respectfully submitted that this is not the case.

Core structure 22 of Best is not an absorbent matrix, but rather the structure which separates the two skins of thermocell 18 to permit liquid 24 to flow therethrough (see col. 4, lines 29-31). This element is therefore not a matrix impregnated with a liquid/solid phase change material as called for in claim 2. It is therefore respectfully submitted that this rejection, too, should be withdrawn, and that claim 2 is allowable for this independent reason.

Turning to the §112 rejection of claim 11, the applicant has removed the dual-range ambiguity from claim 11, and added a new claim 29, depending from claim 11. Claim 29 contains the (second) narrowing range deleted from claim 11 by the above amendment.

the remainder of the specification, and does not refer to °C at any other location.

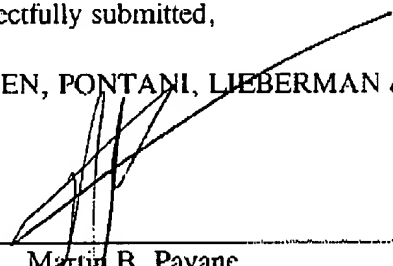
For all these reasons, therefore, it is respectfully submitted that the claims present allowable subject matter, and are in allowable form. Early and favorable action towards that end is respectfully solicited.

It is believed that no fees or charges are required at this time in connection with the present application; however, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,

COHEN, PONTANI, LIEBERMAN & PAVANE

By



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Dated: February 11, 2002

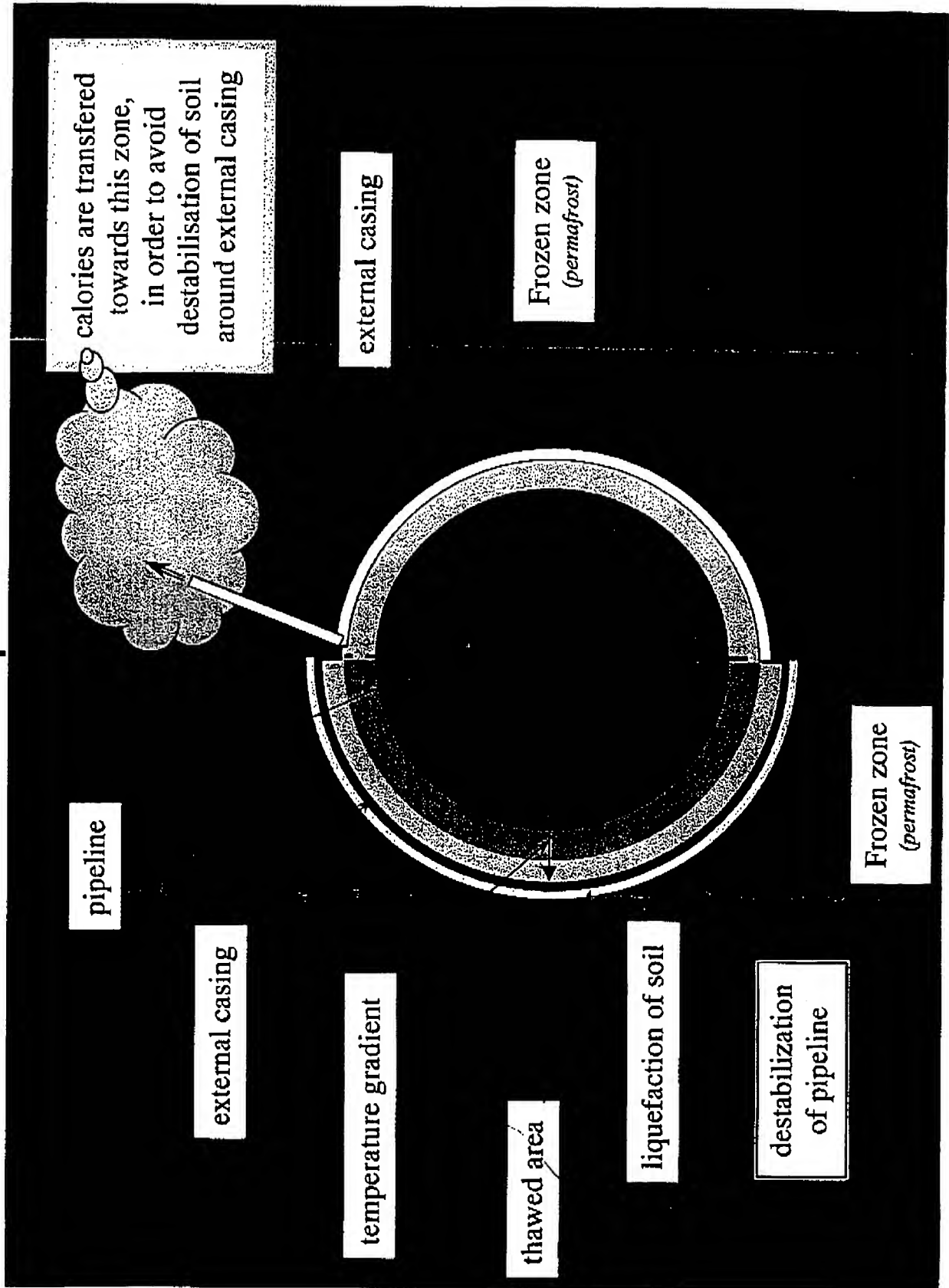
MARKED UP COPY OF CLAIMS

11. (Twice Amended) Device according to claim 1, characterized in that said virtually incompressible material (4) is constituted, to at least 90%, of chemical compounds of the family of alkanes [preferably a paraffin comprising a hydrocarbon chain with at least 10 carbon atoms].

29. (New) Device according to claim 11, wherein said incompressible material (4) is a paraffin comprising a hydrocarbon chain with at least 10 carbon atoms.

30. (New) Device according to claim 1, wherein said at least one underwater pipe is disposed on said sea bed.

as per patent US-3,948,313




UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

 Address: COMMISSIONER OF PATENTS AND TRADEMARKS
 Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/073-200	06/23/02	DAYLUT	03440-77012

 MARTIN S FAVANE
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 351 FIFTH AVENUE SUITE 1400
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SP102/LUNO

EXAMINER

MULLEN, T

ART UNIT

PAPER NUMBER

3733

DATE MAILED:

10/01/02

9 Jan 02

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

COHEN, PONTANI, LIEBERMAN & FAVANE

OCT 11 2001

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 P04235US0
 Assigned? 3

Office Action Summary

Application No.

09/623,208

Applicant(s)

BAYLOT ET AL

Examiner

Terrell L Mckinnon

Art Unit

3743

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may receive any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 August 2000.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 26-28 is/are allowed.
- 6) ☒ Claim(s) 1-6, 8, 10 and 11 is/are rejected.
- 7) ☒ Claim(s) 7, 9 and 12-25 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 August 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a)
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner
If approved, corrected drawings are required in reply to this Office action
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s).
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other:

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DETAILED ACTION

Specification

The following guidelines illustrate the preferred layout and content for patent applications. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

The following order or arrangement is preferred in framing the specification and, except for the reference to "Microfiche Appendix" and the drawings, each of the lettered items should appear in upper case, without underlining or bold type, as section headings. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

- (a) Title of the Invention.
- (b) Cross-References to Related Applications.
- (c) Statement Regarding Federally Sponsored Research or Development.
- (d) Reference to a "Microfiche Appendix" (see 37 CFR 1.96).
- (e) Background of the Invention.
 - 1. Field of the Invention.
 - 2. Description of the Related Art including information disclosed under 37 CFR 1.97 and 1.98.
- (f) Brief Summary of the Invention.
- (g) Brief Description of the Several Views of the Drawing(s).
- (h) Detailed Description of the Invention.
- (i) Claim or Claims (commencing on a separate sheet).
- (j) Abstract of the Disclosure (commencing on a separate sheet).
- (k) Drawings.
- (l) Sequence Listing (see 37 CFR 1.821-1.825).

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

A broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since

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the resulting claim does not clearly set forth the metes and bounds of the patent protection desired.

Note the explanation given by the Board of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d 2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language.

The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949).

In the present instance, claim 11 recites the broad recitation "virtually incompressible material is constituted, to at least 90%, of chemical compounds of the family of alkanes", and the claim also recites "preferably a paraffin comprising a hydrocarbon chain with at least 10 carbon atoms" which is the narrower statement of the range/limitation.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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2. Claims 1-6, 8, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Best (U.S. 3,948,313) in view of Watkins (U.S. 6,058,979).

Best discloses an arrangement to control heat flow between a member and its environment comprising:

- a device for insulating at least one underwater pipe (column 1, lines 1-23);
- an insulating coating (17 and 18) surrounding the pipe (12) and a protective envelope (skins 20);
- the insulating coating (18) comprises a virtually incompressible liquid/solid phase change material (24) with a melting temperature higher (between 20 and 80 degrees Celsius) than that of the medium surrounding the pipe, and less than that of the effluents circulating in the pipe (column 4, lines 47-53, lines 59-60, and column 3, lines 54-55);
- the use of designing the thermal cell to allow for expansion and contraction of the liquid (24) as the temperature changes (column 4, lines 67-column 5, line 2);
- the protective envelope (cylindrical skins 20) is resistant, deformable and ensures containment about the insulating coating and support for the pipe (column 4, lines 35-38);
- the insulating coating comprises an light, cellular or fibrous absorbent matrix (matrix 22) surrounding the outside of the pipe preferably

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nearest its outer surface (column 11, lines 7-30) and impregnated with the liquid/solid phase change material (column 4, lines 29-49, and see fig. 11); and

- the use of the protective envelope comprising at least one vent permeable to the gas that may diffuse through the underwater pipe (column 2, lines 9-20).

Best fails to disclose the protective envelope being made of thermoplastic material.

3. However, Watkins teaches the use of a deep-sea insulated pipeline including a protective cover made of a thermoplastic material (column 4, lines 8-11).

Given the teachings of Watkins, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the outer protective pipe of Best with a protective envelope being made of thermoplastic material.

Doing so would provide a protective cover that's flexible hard and tough.

Allowable Subject Matter

Claims 26-28 are allowed.

Claims 7, 9, 13, and 16-25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 12, 14, and 15 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to

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include all of the limitations of the base claim and any intervening claims.


Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following references are cited for related limitations of the applicants claimed and disclosed invention. Costes, Matthieu et al, Schmiade, Leon et al, Krieg et al, C.H. Parsons et al, Deutsch, Pugh, and Best ('502).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Terrell L Mckinnon whose telephone number is 703-305-0059. The examiner can normally be reached on Monday -Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ^{Henry Bennett (703) 308-0101} ~~Ira Lazarus~~ can be reached on ~~308-1935~~. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7764 for regular communications and 703-308-7764 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-1148.


TM
September 28, 2001

Ira S. Lazarus
Supervisory Patent Examiner
Group 3700

Notice of References Cited	Application/Control No. 09/623,208		Applicant(s)/Patent Under Reexamination BAYLOT ET AL.	
	Examiner Terrell L Mckinnon		Art Unit 3743	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification	
	A	US-3,990,502-A	11-1976	Best	165	45
	B	US-4,408,657-A	10-1983	Pugh	138	112
	C	US-3,809,149-A	05-1974	Deutsch	165	45
	D	US-2,707,095-A	04-1955	C.H. Parsons et al.	165	45
	E	US-5,050,386-A	09-1991	Krieg et al.	62	260
	F	US-4,327,560-A	05-1982	Leon et al.	62	260
	G	US-3,948,313-A	04-1976	Best	165	45
	H	US-6,199,593-B1	03-2001	Schminade	138	114
	I	US-6,058,979-A	05-2000	Watkins	138	114
	J	US-3,933,182-A	01-1976	Costes	138	114
	K	US-3,698,440-A	10-1972	Matthieu et al.	138	114
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification	
	N						
	O						
	P						
	Q						
	R						
	S						
	T						

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)					
	U						
	V						
	W						
	X						

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
 Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

CLAIMS

1. Device for the heat insulation of at least one underwater pipe (1) intended to be laid on the sea bed at great depth, comprising an insulating coating surrounding the latter and a protective envelope (3), characterized in that said insulating coating comprises a virtually
5 incompressible liquid/solid phase change material (4) with a melting temperature T_0 higher than that T_2 of the medium surrounding the pipe in operation and less than that T_1 of the effluents circulating in said pipe, which protective envelope (3) is resistant and deformable and ensures a containment about said insulating coating.
2. Heat insulation device according to Claim 1, characterized in that said insulating
10 coating comprises an absorbent matrix (2) surrounding said pipe (1), preferably nearest its outer surface, and impregnated with said material (4).
3. Heat insulation device according to Claim 1 or 2, characterized in that the protective envelope (3), abutting on the material (4) which is solidified and rigid at least on its periphery, is adapted to support the weight of the pipe (1) and the frictions when the latter is laid from
15 the surface.
4. Heat insulation device according to any one of Claims 1 to 3, characterized in that the protective envelope (3) is deformable in order to follow the variations in volume of the insulating coating that it contains under the effect of the hydrostatic pressure and upon variations in temperature.
- 20 5. Heat insulation device according to any one of Claims 1 to 4, characterized in that the protective envelope (3) comprises at least one vent permeable to the gas that may diffuse through said underwater pipe (1) and generated by the effluents which circulate therein.
6. Device according to any one of Claims 2 to 5, characterized in that the matrix (2) is constituted by a light, cellular or fibrous material and said virtually incompressible material
25 (4) which impregnates it has a melting temperature (T_0) included between 20 and 80°C.
7. Device according to any one of Claims 1 to 6, characterized in that said material (4) has a thermal conductivity less than 0.3 Watt/meter/degree Celsius in solid phase and an enthalpy of fusion greater than 50 kilojoule/kilogram.
8. Insulation device according to any one of Claims 2 to 7, characterized in that said
30 matrix (2) occupies only a part of the volume of the annular space defined by said protective envelope (3) and said pipe (1).

9. Device according to any one of Claims 1 to 8, characterized in that it comprises distance pieces (9) regularly spaced apart along the pipe (1) on which they abut and supporting the protective envelope (3).
10. Device according to any one of Claims 1 to 9, characterized in that the protective envelope (3) is made of thermoplastics material.
11. Device according to any one of Claims 1 to 10, characterized in that said virtually incompressible material (4) is constituted, to at least 90%, of chemical compounds of the family of alkanes, preferably a paraffin comprising a hydrocarbon chain with at least 10 carbon atoms.
12. Device according to Claim 11, characterized in that said virtually incompressible material (4) comprises a paraffin comprising a hydrocarbon chain with at least 14 carbon atoms.
13. Heat insulation device according to one of Claims 1 to 12, characterized in that the outer perimeter (24) of the transverse section of said protective envelope (3) is a closed curve of which the ratio of the square of the length over the surface that it defines is at least equal to 13.
14. Device according to Claim 12, characterized in that the outer shape of the transverse section of said protective envelope (3) is an oval.
15. Device according to Claim 14, characterized in that the ratio of length of the large axis over that of the small axis of the oval is at least 2.
16. Device according to Claim 13, characterized in that the outer shape of the transverse section of said protective envelope (3) is a rectangle.
17. Device according to any one of Claims 13 to 16, characterized in that it comprises at least two pipes (1) disposed along the same plane and the transverse section of said envelope (3) is of shape elongated in the same direction as this plane.
18. Device according to any one of Claims 13 to 16, characterized in that the perimeter (24) of the transverse section of said envelope (3) comprises concave reversed curvatures (35).
19. Device according to any one of Claims 13 to 18, characterized in that it comprises a wear plate (21) disposed on a part of said outer perimeter (24) of the envelope (3).
20. Device according to Claim 19 and according to any one of Claims 14 to 17, characterized in that said wear plate (21) is disposed along one of the large sides of the

transverse section of said envelope (3).

21. Device according to any one of Claims 13 to 20, characterized in that the ratio of the square of the length of the outer perimeter (24) of the transverse section of said protective envelope (3) on the surface that said perimeter defines is at least equal to 16.

5 22. Device according to any one of Claims 13 to 21, characterized in that the protective envelope (3) comprises a lower "U"-shaped part (3₁) in which are disposed said pipes (1) and a lid (34) assembled on this envelope (3).

23. Device according to Claim 22, characterized in that said lid (34) is seam-welded.

10 24. Device according to any one of Claims 13 to 23, characterized in that the protective envelope (3) comprises a lower "U"-shaped part (3₁) in which are disposed said pipes (1) and an upper opening closed by a layer (31) of supple material cast after installation of all the internal components.

25. Device according to any one of Claims 13 to 24, characterized in that the envelope (3) comprises shims (27) supporting the insulating coating (2), the space included between the
15 envelope (3) and said coating (2) being filled with a virtually incompressible fluid (4).

26. Process for the heat insulation of at least one underwater pipe (1) intended to be laid on the sea-bed at great depth, using an insulating coating surrounding said pipe and a protective envelope (3), characterized in that:

- said pipe (1) is surrounded, preferably directly, with an insulating coating (2) comprising a virtually incompressible, liquid-solid phase change material (4) with a given
20 melting temperature T_0 , said incompressible material preferably being impregnated in an absorbant matrix, and the whole is contained in the protective envelope (3) which must be resistant and deformable,

- there are made to circulate in said pipe (1) hot effluents (6) at a temperature T_1 higher
25 than the melting temperature T_0 of said material (4) while the ambient outside temperature T_2 is less than T_0 , the phase change material (4) then being liquefied, preferably in a part of the impregnation matrix (2₁) from the pipe (1) up to a limit of heat exchange equilibrium (19) between the pipe (1) and the envelope (3), beyond this limit (19) the material being solid,

- when the circulation of the effluents (6) in the pipe (1) is stopped, the temperature of
30 these effluents (6) is maintained above a given temperature T_3 for a predetermined duration thanks to the heat transfer brought by the latent heat of solidification of said material (4) of

which the liquid part (4₁) solidifies progressively on cooling.

27. Process of heat insulation according to Claim 26, characterized in that:

- an obturator (7₂) is fixed in continuous and tight manner at the end of the outer wall of pipe (1) to be insulated;

5 - there are mounted on this part of pipe (1) elements of the absorbent matrix (2) which surround the latter completely and uniformly,

- there is fitted around these matrix elements (2) the outer protective envelope (3) which is connected at its end to the obturator (7₂),

- there is positioned at the other end of the protective envelope (3) a second obturator (7₁)

10 which is fixed on this envelope and on the pipe (1),

- the annular space included between the pipe (1) and the envelope (3) is completely filled, via one end, with said phase change material (4) liquefied and overheated above its melting temperature T₀ and until the matrix elements (2) are completely impregnated with it,

- the whole is cooled.

15 28. Process of heat insulation according to Claim 27, characterized in that:

- there are interposed between absorbent matrix elements (2), distance pieces (9) regularly spaced along the pipe (1) on which they abut,

- when all the elements of the protective element (3) have been placed in position and fixed to constitute the containment envelope, straps (17) for holding said distance pieces (9) plumb are

20 placed in position,

- the annular space is then filled with said liquefied material (4) under pressure in order to deform the outer envelope (3) between said straps (17), which deformation corresponding to the increase in volume generated by the thermal expansion of the material (4) liquid at filling temperature.

Device and process for the heat insulation of at least one underwater pipe at great depth

ABSTRACT

5 The present invention relates to a device for the heat insulation of at least one
underwater pipe (1) intended to be laid on the sea bed at great depth, comprising an insulating
coating surrounding the latter and a protective envelope (3), characterized in that said
insulating coating comprises a virtually incompressible liquid/solid phase change material (4)
with a melting temperature T_0 higher than that T_2 of the medium surrounding the pipe in
10 operation and less than that T_1 of the effluents circulating in the pipe, and said material (4)
preferably being impregnated in an absorbent matrix (2) surrounding the pipe (1), preferably
nearest its outer surface, which protective envelope (3) is resistant and deformable and ensures
a containment against and about said insulating coating.

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Attorney Docket # 33900-73PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of

Michel BAYLOT et al.

International Appln. No.: PCT/FR99/03322

International Filing Date: 30 December 1999

For: Device and Process for the Heat Insulation of at
Least One Underwater Pipe at Great DepthPRELIMINARY AMENDMENTAssistant Commissioner for Patents
Washington, D.C. 20231
BOX PCT

S I R:

Prior to examination of the above-identified application please amend the application as follows:

In the Claims:

Please amend claims 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 17, 18, 19, 20, 21, 22, 24, and 25 as follows:

3. Heat insulation device according to Claim 1 [or 2], characterized in that the protective envelope (3) abutting on the material (4) which is solidified and rigid at least on

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its periphery, is adapted to support the weight of the pipe (1) and the frictions when the latter is laid from the surface.

4. Heat insulation device according to [any one of claims 1 to 3] claim 1, characterized in that the protective envelope (3) is deformable in order to follow the variations in volume of the insulating coating that it contains under the effect of the hydrostatic pressure and upon variations in temperature.

5. Heat insulation device according to [any one of claims 1 to 4] claim 1, characterized in that the protective envelope (3) comprises at least one vent permeable to the gas that may diffuse through said underwater pipe (1) and generated by the effluents which circulate therein.

6. Device according to [any one of claims 2 to 5] claim 2, characterized in that the matrix (2) is constituted by a light, cellular or fibrous material and said virtually incompressible material (4) which impregnates it has a melting temperature (T_0) included between 20 and 80°C.

7. Device according to [any one of claims 1 to 6] claim 1, characterized in that said material (4) has a thermal conductivity less than 0.3 Watt/meter/degree Celsius in solid phase and an enthalpy of fusion greater than 50 kilojoule/kilogram.

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8. Insulation device according to [any one of claims 2 to 7] claim 2, characterized in that said matrix (2) occupies only a part of the volume of the annular space defined by said protective envelope (3) and said pipe (1).
9. Device according to [any one of claims 1 to 8] claim 1, characterized in that it comprises distance pieces (9) regularly spaced apart along the pipe (1) on which they abut and supporting the protective envelope (3).
10. Device according to [any one of claims 1 to 9] claim 1, characterized in that the protective envelope (3) is made of thermoplastics material.
11. Device according to [any one of claims 1 to 10] claim 1, characterized in that said virtually incompressible material (4) is constituted, to at least 90%, of chemical compounds of the family of alkanes, preferably a paraffin comprising a hydrocarbon chain with at least 10 carbon atoms.
13. Heat insulation device according to [one of claims 1 to 12] claim 1, characterized in that the outer perimeter (24) of the transverse section of said protective envelope (3) is a closed curve of which the ratio of the square of the length over the surface that it defines is at least equal to 13.
17. Device according to [any one of claims 13 to 16] claim 16, characterized in that it comprises at least two pipes (1) disposed along the same plane and the transverse section of

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said envelope (3) is of shape elongated in the same direction as this plane.

18. Device according to [any one of claims 13 to 16] claim 13, characterized in that the perimeter (24) of the transverse section of said envelope (3) comprises concave reversed curvatures (35).

19. Device according to [any one of claims 13 to 18] claim 13, characterized in that it comprises a wear plate (21) disposed on a part of said outer perimeter (24) of the envelope (3).

20. Device according to claim 19 [and according to any one of claims 14 to 17], characterized in that said wear plate (21) is disposed along one of the large sides of the transverse section of said envelope (3).

21. Device according to [any one of claims 13 to 20] claim 13, characterized in that the ratio of the square of the length of the outer perimeter (24) of the transverse section of said protective envelope (3) on the surface that said perimeter defines is at least equal to 16.

22. Device according to [any one of claims 13 to 21] claim 13, characterized in that the protective envelope (3) comprises a lower "U"-shaped part (3₁) in which are disposed said pipes (1) and a lid (34) assembled on this envelope (3).

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24. Device according to [any one of claims 13 to 23] claim 13, characterized in that the protective envelope (3) comprises a lower "U"-shaped part (3,) in which are disposed said pipes (1) and an upper opening closed by a layer (31) of supple material cast after installation of all the internal components.

25. Device according to [any one of claims 13 to 24] claim 13, characterized in that the envelope (3) comprises shims (27) supporting the insulating coating (2), the space included between the envelope (3) and said coating (2) being filled with a virtually incompressible fluid (4).

REMARKS

This preliminary amendment is presented merely to eliminate multiple dependency from the present claims. No new matter has been added. Early examination and favorable consideration of the above-identified application is earnestly solicited.

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Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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29 August 2000

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